TRIODE–OUTPUT PENTODE

Triode pentode with separate cathodes.
The triode section is intended for use as A.F. amplifier.
The pentode section is intended for use as A.F. power amplifier.

QUICK REFERENCE DATA			
Triode section			
Anode current	I_a	1.2	mA
Transconductance	S	1.6	mA/V
Amplification factor	μ	100	-
Pentode section			
Anode current	I_a	36	mA
Transconductance	S	10	mA/V
Amplification factor	$\mu_{g_2g_1}$	21	-
Output power	W_o	4.0	W

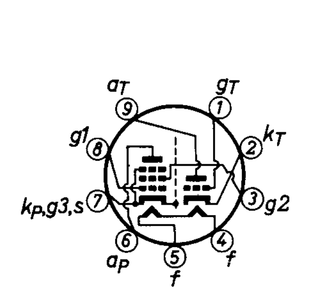
HEATING: Indirect by A.C. or D.C.; parallel supply

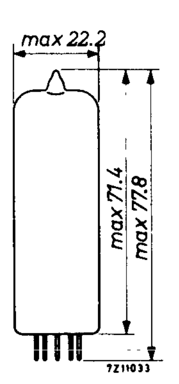
Heater voltage	V_f	6.3	V
Heater current	I_f	660	mA

DIMENSIONS AND CONNECTIONS

Dimensions in mm

Base: Noval





CAPACITANCES

Triode section

Anode to all except grid	$C_{a(g)}$	2.5	pF
Grid to all except anode	$C_{g(a)}$	2.3	pF
Anode to grid	C_{ag}	1.4	pF
Grid to heater	C_{gf}	max. 0.006	pF

Pentode section

Grid No.1 to all except anode	$C_{g_1(a)}$	10	pF
Anode to grid No.1	C_{ag_1}	max. 0.4	pF
Grid No.1 to heater	C_{g_1f}	max. 0.24	pF

Between triode and pentode sections

Anode triode to grid No.1 pentode	C_{aTg_1P}	max. 0.2	pF
Grid triode to grid No.1 pentode	C_{gTg_1P}	max. 0.02	pF
Anode triode to anode pentode	C_{aTaP}	max. 0.15	pF
Grid triode to anode pentode	C_{gTaP}	max. 0.006	pF [1]

TYPICAL CHARACTERISTICS

Triode section

Anode voltage	V_a	250	V
Grid voltage	V_g	-1.9	V
Anode current	I_a	1.2	mA
Transconductance	S	1.6	mA/V
Amplification factor	μ	100	-

Pentode section

Anode voltage	V_a	250	V
Grid No.2 voltage	V_{g_2}	250	V
Grid No.1 voltage	V_{g_1}	-7	V
Anode current	I_a	36	mA
Grid No.2 current	I_{g_2}	6	mA
Transconductance	S	10	mA/V
Amplification factor	$\mu_{g_2g_1}$	21	-
Internal resistance	R_i	48	kΩ

[1]) The capacitance between triode grid and pentode anode (C_{gT-aP}) can be reduced to a value of less than 0.002 pF by using a shielding ring with a diameter of 22.5 mm and a height of 15 mm with respect to the tube base.

OPERATING CHARACTERISTICS

Triode section

as A.F. amplifier

Supply voltage	V_b	200	250	250	300	V
Cathode resistor	R_k	2.6	1.75	1.75	1.2	kΩ
Anode resistor	R_a	220	220	220	220	kΩ
Grid resistor of following stage	$R_{g'}$	0.68	0.68	10	10	MΩ
Anode current	I_a	0.42	0.6	0.6	0.8	mA
Output voltage	V_o	3.2	3.2	5	9	V_{RMS}
Voltage gain	V_o/V_i	66	70	75	80	-
Distortion	d_{tot}	0.6	0.4	0.4	0.4	%

A.F. amplifier with grid current biasing

Supply voltage	V_b	200	250	250	300	V
Cathode resistor	R_k	0	0	0	0	Ω
Anode resistor	R_a	220	220	220	220	kΩ
Grid resistor	R_g	10	10	10	10	MΩ
Grid resistor of following stage	$R_{g'}$	0.68	0.68	10	10	MΩ
Signal source resistance	R_s	47	47	47	47	kΩ
Anode current	I_a	0.42	0.6	0.6	0.8	mA
Output voltage	V_o	3.2	3.2	5	9	V_{RMS}
Voltage gain	V_o/V_i	66	70	75	80	-
Distortion	d_{tot}	0.6	0.4	0.4	0.4	%

MICROPHONY

The triode section can be used without special precautions against microphonic effect in circuits in which an output of 50 mW is obtained at an input voltage of not less than 4 mV_{RMS}.

HUM

The hum level will be better than 60 dB under the following conditions:
Input voltage minimum 10 mV_{RMS} for 50 mW output.
Grid circuit impedance max. 0.5 MΩ at 50 Hz.
Cathode decoupling capacitor minimum 100 μF.
Pin 4 connected to earth.

OPERATING CHARACTERISTICS (continued)

Pentode section

Class A (Measured with V_k constant)

Anode voltage	V_a		250			250		V
Grid No.2 voltage	V_{g2}		250			250		V
Cathode resistor	R_k		170			270		Ω
Load resistance	$R_{a\sim}$		7			10		kΩ
Grid No.1 driving voltage	V_i	0	0.3	3.2	0	0.28	2.7	V_{RMS}
Anode current	I_a	36	-	37	26	-	27	mA
Grid No.2 current	I_{g2}	6	-	10.2	4.4	-	8.0	mA
Output power	W_o	0	0.05	4.0	0	0.05	2.8	W
Distortion	d_{tot}	-	0.95	10	-	1.1	10	%

Class AB, two tubes in push-pull

Supply voltage	V_b		250			300		V
Common cathode resistor	R_k		90			130		Ω
Load resistance	$R_{aa\sim}$		8.2			9.1		kΩ
Grid No.1 driving voltage	V_i	0	0.24	5.5	0	0.26	8.4	V_{RMS}
Anode current	I_a	2x32.5	-	2x35.5	2x31	-	2x36.5	mA
Grid No.2 current	I_{g2}	2x5.6	-	2x8.9	2x5.5	-	2x11	mA
Output power	W_o	0	0.05	10	0	0.05	13.6	W
Distortion	d_{tot}	-	<0.4	5.0	-	<0.4	4.0	%

LIMITING VALUES (Design centre rating system)

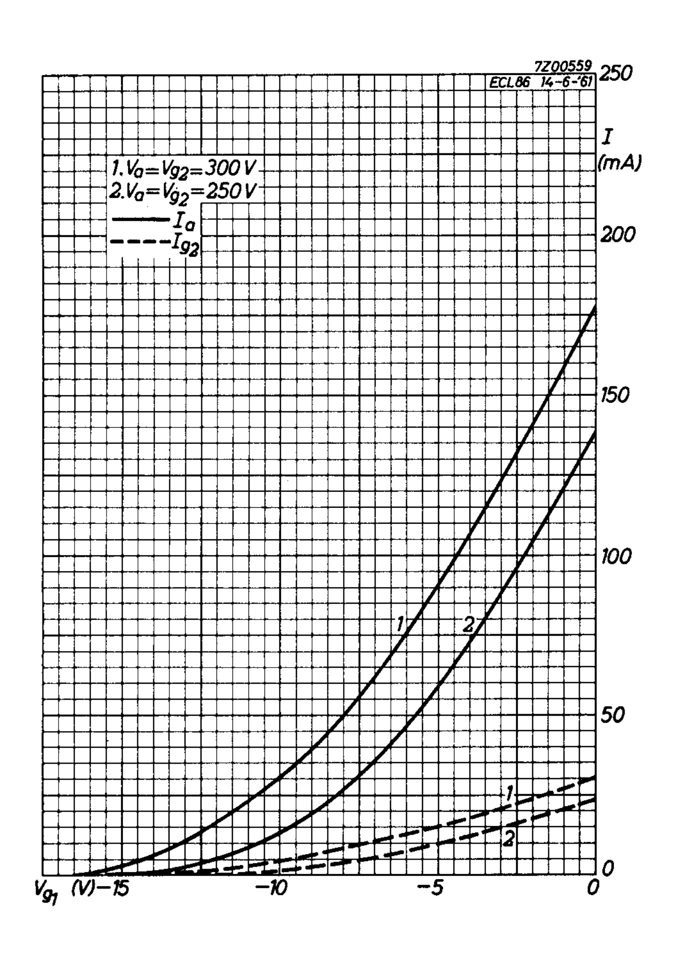
Triode section

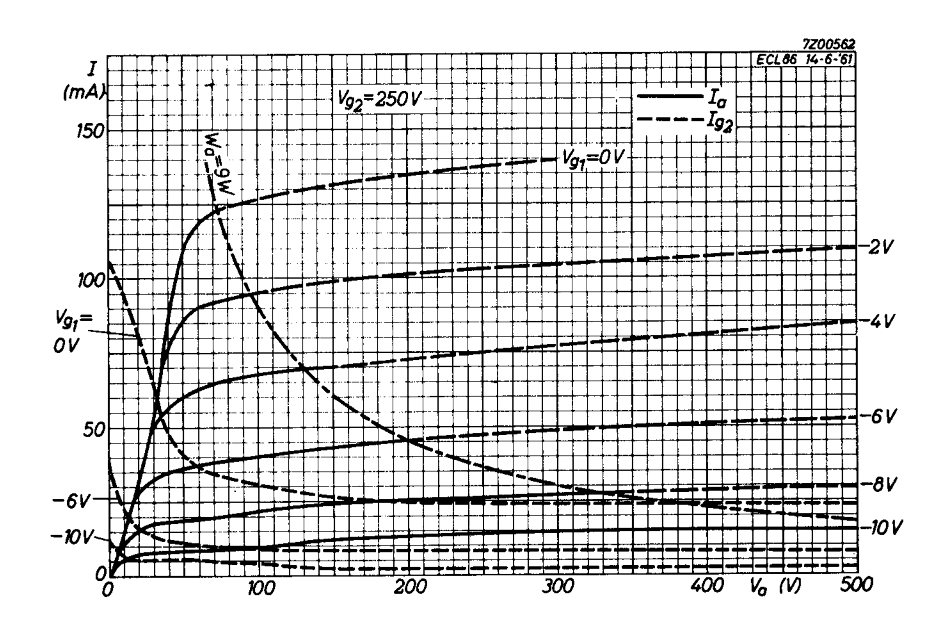
Anode voltage	V_{a_o}	max.	550	V
	V_a	max.	300	V
Anode dissipation	W_a	max.	0.5	W
Cathode current	I_k	max.	4	mA
Grid resistor	R_g	max.	1	MΩ [1]
Cathode to heater voltage	V_{kf}	max.	100	V

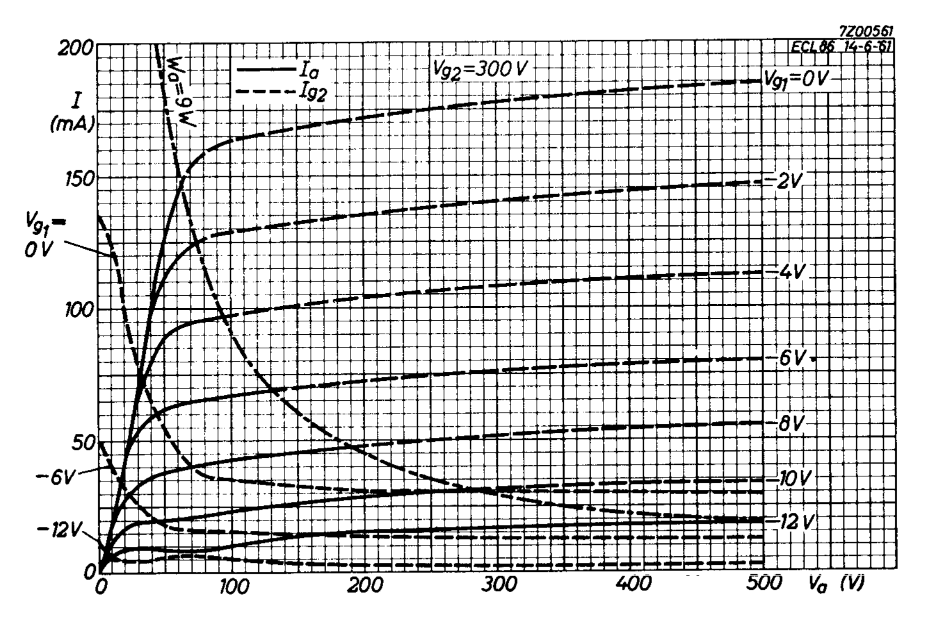
Pentode section

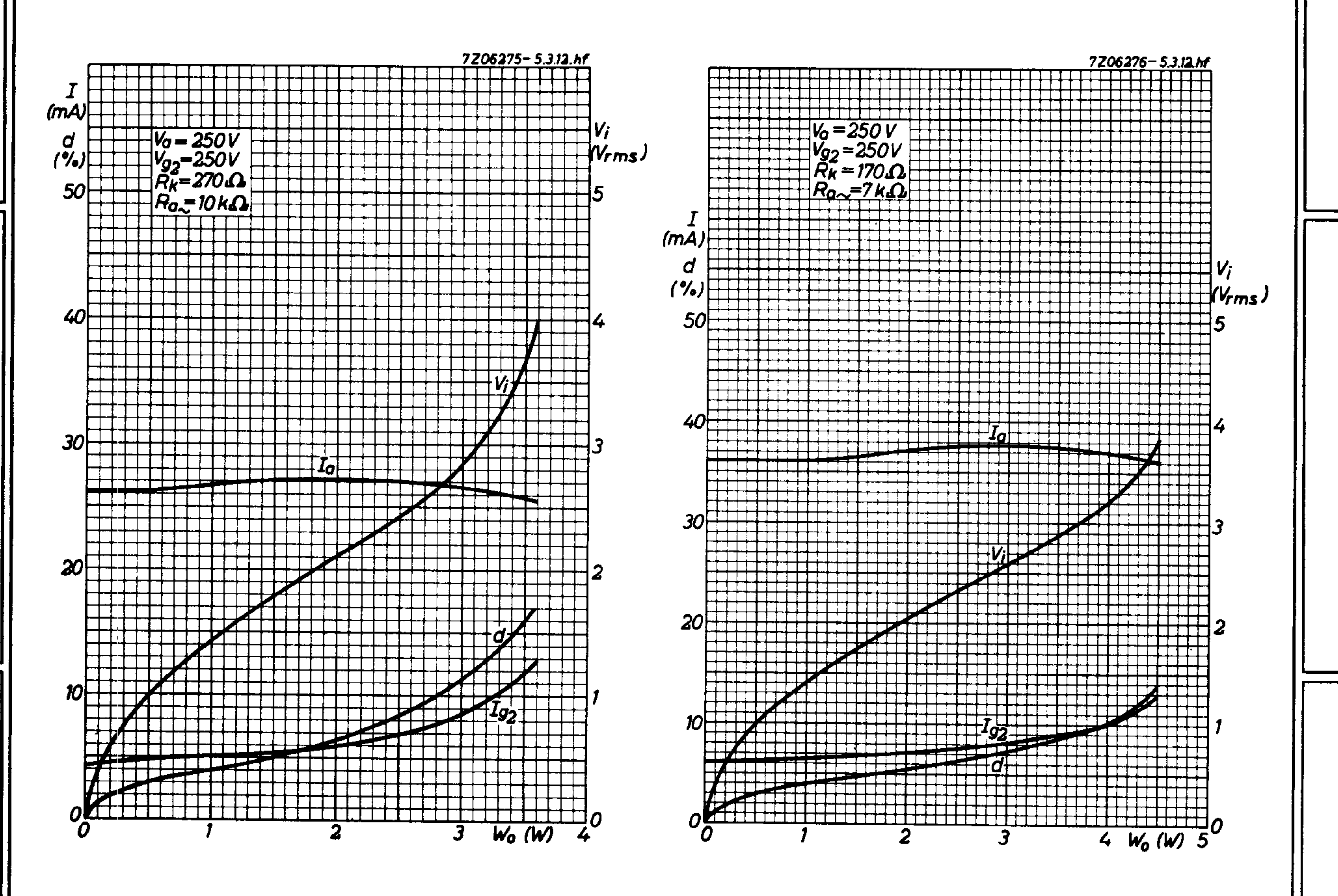
Anode voltage	V_{a_o}	max.	550	V
	V_a	max.	300	V
Grid No.2 voltage	$V_{g_{2o}}$	max.	550	V
	V_{g_2}	max.	300	V
Anode dissipation	W_a	max.	9	W
Grid No.2 dissipation				
average	W_{g_2}	max.	1.8	W
peak	$W_{g_{2p}}$	max.	3.25	W
Cathode current	I_k	max.	55	mA
Grid No.1 resistor	R_{g_1}	max.	0.5	MΩ [1]
Cathode to heater voltage	V_{kf}	max.	100	V

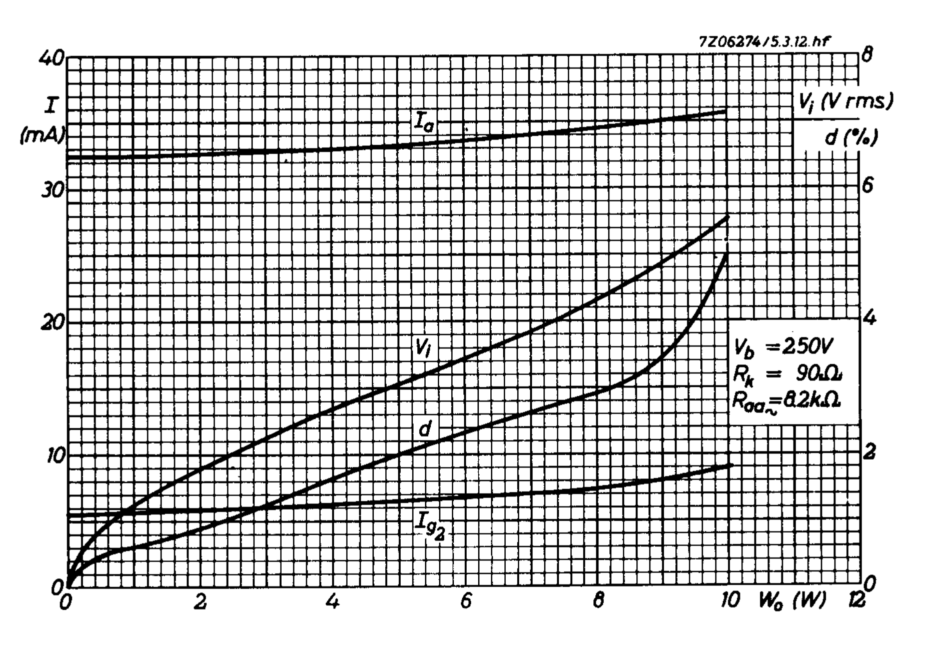
[1]) This value applies to operation with fixed bias. It may be multiplied by the D.C. inverse feedback factor resulting from e.g. cathode, screen grid or anode resistors, to a maximum of 10 MΩ.

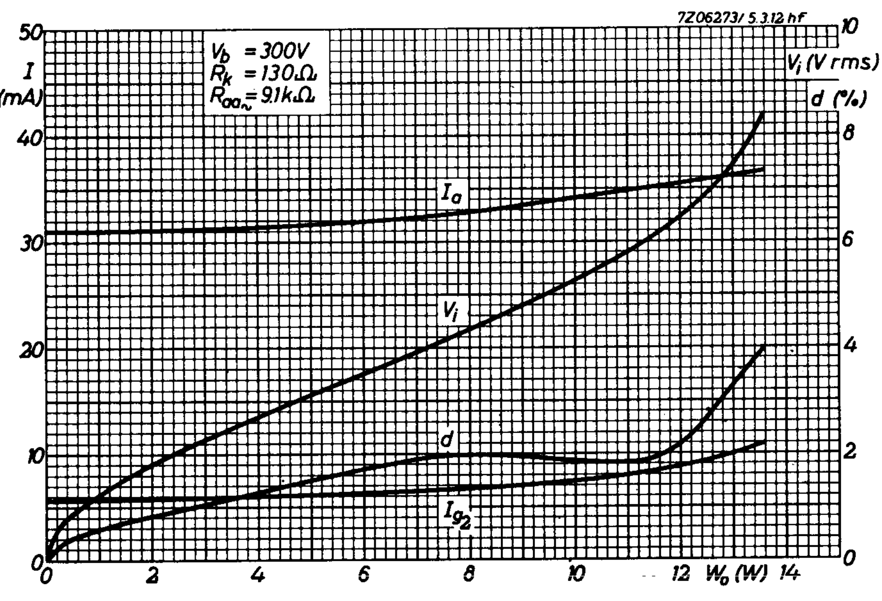

7Z00559
ECL86 14-6-'61
1. $V_a = V_{g2} = 300$ V
2. $V_a = V_{g2} = 250$ V
I_a
I_{g2}
I (mA)
250
200
150
100
50
0
1
2
1
2
V_{g1} (V) −15
−10
−5
0


7Z00562
ECL86 14-6-'61
I (mA)
V_{g2}=250V
I_a
I_{g2}
W_a=9W
V_{g1}=0V
-2V
-4V
-6V
-8V
-10V
V_{g1}= 0V
-6V
-10V
150
100
50
0
0
100
200
300
400
500
V_a (V)

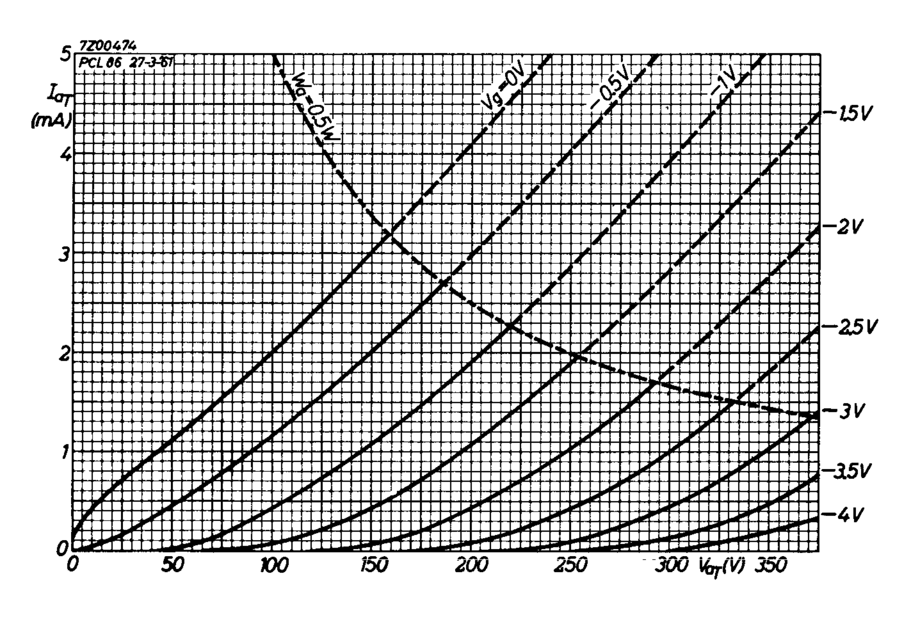

7Z00561
ECL86 14-6-'61
I (mA)
V_{g2}=300V
I_a
I_{g2}
W_a=9W
V_{g1}=0V
-2V
-4V
-6V
-8V
-10V
-12V
V_{g1}= 0V
-6V
-12V
200
150
100
50
0
0
100
200
300
400
500
V_a (V)

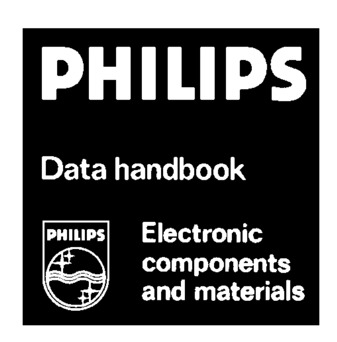

7Z06275-5.3.12.hf
I (mA)
d (%)
V_a = 250 V
V_{g2} = 250 V
R_k = 270 Ω
$R_{a\sim}$ = 10 kΩ
V_i (V_{rms})
V_i
I_a
d
I_{g2}
W_o (W)
7Z06276-5.3.12.hf
V_a = 250 V
V_{g2} = 250 V
R_k = 170 Ω
$R_{a\sim}$ = 7 kΩ
I (mA)
d (%)
V_i (V_{rms})
I_a
V_i
I_{g2}
d
W_o (W)


7Z06274/5.3.12.hf
I (mA)
V_i (V rms)
d (%)
I_a
V_i
d
I_{g_2}
V_b = 250V
R_k = 90Ω
$R_{aa\sim}$ = 8.2kΩ
W_o (W)
0
2
4
6
8
10
12
10
20
30
40


7Z06273/5.3.12.hf
V_b = 300V
R_k = 130Ω
$R_{aa\sim}$ = 9.1kΩ
I (mA)
V_i (V rms)
d (%)
I_a
V_i
d
I_{g_2}
W_o (W)
0
2
4
6
8
10
12
14
20
30
40
50

7Z00560
ECL86 14-6-'61
I_{a_T} (mA)
6 5 4 3 2 1 0
V_{aT} = 250 V
V_{g_T} (V)
0 −1 −2 −3 −4





ECL86

page	sheet	date
1	1	1970.01
2	2	1970.01
3	3	1970.01
4	4	1970.01
5	5	1970.01
6	6	1970.01
7	7	1970.01
8	8	1970.01
9	9	1970.01
10	10	1970.01
11	FP	1999.08.10